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Ian B Oliver

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Kirstenbosch Gardening Series

GROW
SUCCULENTS



**A GUIDE TO THE SPECIES, CULTIVATION
AND PROPAGATION OF SOUTH AFRICAN SUCCULENTS**

Text by Ian B Oliver

Photographs by Deon Viljoen, Ian Oliver, Ernst van Jaarsveld and
the Percy Sargeant Memorial Collection
Grafting illustrations by Jeanette Loedolff

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**South African National
Biodiversity Institute**

Right: *Piранthus* sp. belongs to the huge Asclepiad family

Bokbaai vygies, *Dorotheanthus bellidiformis*, are used widely in city parks, traffic islands and home gardens as part of the annual spring display



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Left: *Adenium multiflorum* – the
Impala Lily

Below: *Adromischus maculatus*
growing in shale rock

Right: *Adenium swazicum* is an
ideal subject for container
cultivation





A WHO'S WHO OF SUCCULENTS

* indicates an explanation in the glossary (page 59)

Succulents are one of the most interesting groups of plants and have attracted a considerable following in horticultural circles. They occur in a variety of climatic zones and in various forms, colours, shapes and sizes.

Adeniums, which have poisonous sap, occur naturally in South Africa, Swaziland, Zimbabwe, Malawi, Kenya, Namibia, Angola, Yemen, Somalia, Mozambique and Saudi-Arabia, and produce flowers in striking reds, pinks and mauves – red and white bicour flowers are fairly common. Adeniums, like pachypodiums, are sensitive to frost and waterlogged soils. both adeniums and pachypodiums are normally deciduous during the winter or dry season.

Adenium multiflorum is used as a fish poison in Mozambique and the Northern Province. *A. boehmianum* from northern Namibia is used by the Ovambo as an arrow poison.

Adromischus are compact crassula-like leaf succulents which occur in the arid areas of the Cape and Namibia. One species, *Adromischus trigynus*, occurs on dolorite outcrops as far north as



Bloemfontein. *Adromischus* produce rather insignificant upright flower species. They have decorative leaves and are easy to propagate.

Aloes of all shapes and sizes grow naturally all over Africa (except the extreme north), Madagascar, southern Yemen and southern Saudi-Arabia. Aloe flowers are normally warm oranges, reds and yellows, red and white bicolours are also common. Albino* forms are much in demand.

Aloe ferox, the bitter aloe, is used for making jam, among other things. The leaves are peeled, soaked in lime and



Aloe plicatilis – there 281 *Aloe* species recorded in South Africa, Botswana, Namibia, Lesotho and Swaziland.

Above right: *Aloe ciliaris* comes from the Eastern Cape.

boiled in water. In the Albertinia district of the Western Cape, the leaves are cut from the parent plant and stacked in a pyramid formation, with the cut basal portion facing inwards. The sap then drips down and is collected in a container placed in the centre of the pyramid. Eighteen litres of aloe sap are capable of producing twenty-nine kilograms of dried aloe amber. This amber is exported for medicinal and beauty purposes.

A gel, also produced from *A. ferox*, is used in the manufacture of cosmetics, skin care products and shampoo. These products are known internationally as Cape aloes. *Aloe vera*, originating possibly from Yemen or Ethiopia, is used the world over in producing *Aloe vera* beauty products, which are excellent for promoting the healing of wounds and burns.

Apocynaceae (oleander family). These are caudiciform* plants. See adeniums and pachypodiums.

Asclepiadaceae see hoodias, huernias and stapelias.

Carpobrotus. *Carpobrotus edulis*, the sour fig, is common in sand dunes along the Cape coast and is a fantastic ground cover in impoverished soils. The fruits make excellent jams and syrups.

Conophytums are small cushion-like plants that occur only in the Western, Northern and Eastern Cape and south of Lüderitz in Namibia. They have small cushions of button-like heads and a small apical* slit. During the dry season, they are covered in a protective sheath of dead skin. When in bloom, they resemble lithops, the main morphological difference being in their clump-like appearance. The flowers, resembling miniature shaving brushes, are produced in purple, yellow, pink, cream, and white. Evening-flowering species have a light, sweetish smell.



Cotyledons, commonly known as 'plakkies', occur through most of Africa and into Saudi-Arabia, often growing in rocky terrain and forming clumps. Cotyledons, especially the clump-forming varieties, make ideal container plants. Some species have a waxy substance covering the large, oblong leaves which protects the plant

Above: *Carpobrotus* (foreground)
– there are 13 species
indigenous of South Africa –
nearly all of them found along the
Cape coast and slightly inland

Above left: *Conophytum ficiforme*
– this is the most southerly
growing of the genus

Left: The sap in the leaves of
Cotyledon orbiculata can be used
for removing warts

against water loss and severe winter temperatures. Waxy, bell shaped, bright yellow and orange flowers are borne in winter or spring. Some cotyledons are known to give sheep and goats 'krimpsiekte', a disorder which affects the nervous and muscular systems. In some cases their legs literally shrivel away!



Crassulas are found all over the world in a variety of climates. They flourish in different-sized containers and are ideal subjects for miniature rock gardens or mixed succulent bowls. *Crassula* leaves occur in many different colours – yellow, orange, grey, green and even red.

Crassula lanceolala subsp.

transvaalensis is smoked by the southern Sotho for the relief of headaches.

Cyphostemmas are caudiciform* succulents that occur in arid regions of Africa, with several stocky attractive



varieties originating in Namibia. Known as wild grape because of the red grape-like fruits borne in March and April, they are in fact small, stout, succulent trees. The blue-green, waxy leaves are shed in May/June of each year. In their dormant stage, they look quite ghostly especially on a moonlit



Left above: *Crassula multiflora*

Above: *Crassula subulata*

Cyphostemmas are indigenous to central Namibia and are known as the wild grape



Left: *Dioscorea elephantipes* is known as Elephant foot

Below: *Duvalia caespitosa* (Asclepiadaceae) – there are 31 species in South Africa

Euphorbia caput-medusae named from Greek mythology. This plant won't turn you into stone if you look at it

night. Cyphostemmas make excellent specimen plants, especially when grown in a container.

Dioscoreas are caudiciform* plants that make ideal container subjects. They are found in the Eastern Cape and Little Karoo. The shiny leaves are borne on a flexible tendril which can climb many metres in one growing season. Summer deciduous, they lose their leaves and tendrils during that season and are commonly known as elephant's foot or Hottentot's bread. Some species have medicinal properties. Over 600 species of *dioscoreas* are well known for their deeply fissured caudex*.

Duvalias were named in honour of Henri Duval, a French botanist. Prostrate plants with short, fat stems, they are found in the arid areas of South Africa, Zimbabwe and Namibia. Flower colour varies from dark chocolate through to cream and the blooms smell of carrion*.

Euphorbias are found all over the world. The succulent *euphorbias* occur in Africa, the Canary Islands, Madagascar and eastern India. *Euphorbias* are either dioecious* or monoecious* and range in size from small subterranean plants with

minute branches protruding just above the soil surface, to large arborescent* species over seven metres tall. Some *euphorbias* resemble cricket balls, while others look like beautiful bonsai. The more chunky arborescent forms make ideal container or specimen plants.





Euphorbia ferox is given to sheep in the Karoo during times of drought. The thorns are burnt off by dragging a burning tyre over the bushes, thus making the plant more accessible to the stock.

E. ingens is highly toxic and is known to produce irritation and blistering of the skin. The latex (sap) is so irritating that a single drop causes severe pain and temporary blindness. A small quantity – no more than a few drops – of *E. ingens* sap cast into a small pool stuns fish, which can then be caught with ease. *E. ingens* and *E. triangularis* are possible sources of rubber.

Faucarias, indigenous to the Eastern Cape, are known in some districts as 'tiger's teeth' due to the presence of awn-tipped teeth on the leaf margins. *Faucarias* form compact,

rosette plants, and in some cases the leaves are an attractive reddish colour. The flowers are mainly large and yellow and up to 6cm in diameter.

Fenestrarias, or window plants*, occur from the coastal desert sands south of Lüderitz to the Gariep River (Orange River). The tips of the leaves are transparent, thus allowing sunlight through to the chloroplasts* situated deeper in the leaf. *Fenestrarias* survive by drawing moisture from the mists rolling in from the cold Atlantic. Large yellow/orange and white flowers are borne in early winter.

Gasterias, endemic to South Africa, occur in all provinces except the Free State and North West Province. They resemble aloes in shape, although their leaves are



Gasteria multiplex – all gasterias are endemic to South Africa

Above left: *Faucaria tigrina*

Left: *Fenestraria rhopalophylla* subs. *durantiaca*



generally more fleshy. The genus has recently been revised by Ernst van Jaarsveld who is in charge of succulent collections at Kirstenbosch. The name *Gasteria* originates from the Greek word *gaster*, meaning stomach: the flowers have the shape of a human stomach.

Gibbaeums, which occur mainly in the Little Karoo, form a cushion or mat. Attractive and plumply rotund, the body of the plant is sometimes velvety in texture and can be whitish or silver in colour, occasionally resembling overgrown lithops plants. *Gibbaeums* produce pink to reddish-violet, and sometimes even white, flowers.

Glottiphyllums are indigenous to the Western Cape and Eastern Cape, with nearly two thirds coming from the Little Karoo. The plants are easy to recognize by their fat, tongue-like leaves. Some species turn an interesting purple-red when



exposed to the summer sun. The flowers are glossy yellow and some give off a sweet scent, noticeable in the evening. Certain *glottiphyllums* are known to contain oxalic acid. *Glottiphyllum linguiforme* is used to make bread, as it has yeast-producing properties.

Haworthias centre around the Little Karoo and southern Cape, but they are also indigenous to northern Kwazulu-Natal, Swaziland, Mpumalanga, southern Free State and southern Namibia. These interesting rosette plants resemble miniature aloes and are popular subjects amongst amateur collectors worldwide. There are 46 species of *Haworthia* (this will change with M.B. Bayer's revision of the genus in 1998), they make ideal container



There are now 167 different kinds, including varieties, sub-species and forms of *haworthias* in South Africa and southern Namibia (M.B. Bayer's revision of the genus)

Above left: *Gibbaeum esterhuyseniae* – there are 27 species of *Gibbaeum* and nearly all of them are endemic to the Little Karoo

Left: *Glottiphyllums* are endemic to South Africa. There are 16 species, most of them indigenous to the Eastern Karoo



plants, enhancing mixed succulent bowls, and also do well in miniature rock gardens.

Haworthia maxima (was *H. pumila*), indigenous to the Worcester areas, has soap-producing properties. When the bark is peeled back from the leaves and the soggy remains are immersed in water, a soapy solution is obtained.

Hoodias, known in some areas as 'bergghaap', are restricted to the arid areas of the Northern Cape, Namibia and

Botswana. They are easy to recognise with their stout, prickly, many-angled stems. The large, conspicuous flowers, which resemble petunias, vary in colour from wine-red to shell-pink, and light yellow to cream. Hoodias have a strong carrion smell. They make wonderful container plants and look handsome in terracotta containers. The thornless varieties of hoodias or trichocaulons are now known as lavarionias, in honour of Mr John Lavarous.

Huernias are found throughout Africa and as far as Arabia. They have a slight carrion smell, although this is not nearly as strong as that of the stapelias.

Huernias produce beautifully patterned symmetrical flowers in March and April, in pastel shades of brown, cream, maroon





Opposite: These foul-smelling *Hoodia* flowers are borne during the early spring or early autumn. Flies pollinate them

Above: *Huernia zebrina*

Right: *Kalanchoe thyrsiflora* and *Cotyledon barbeyi*

Below: *Kedrostis nana*



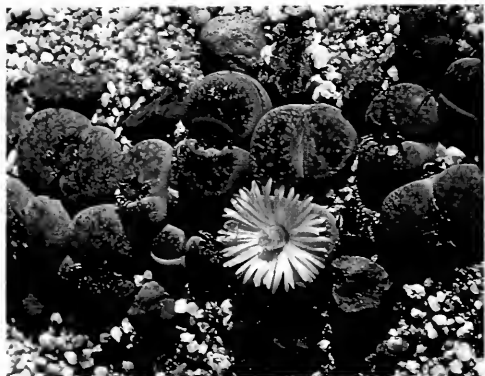
and pink. Along with stapelias, they make interesting container plants, although they are generally smaller in stature.

Kalanchoes occur throughout Africa, Madagascar, Cyprus, Indochina and Malaya and are among the world's most popular container plants. Due to genetic manipulation, flowering *kalanchoes* are marketed in all colours except blue. In Holland, some horticultural firms produce literally millions of one colour for the European and US markets.

The southern Sothos use *Kalanchoe thyrsiflora* as a charm to soothe away difficulties.

Succulent *kedrostis*, caudiciform* members of the cucumber family (Cucurbitaceae), occur in South Africa, Madagascar and tropical Africa. They grow quickly and easily from cuttings or seed.

Kedrostis africana, from the Western Cape, is a good example of a caudiciform* plant. In north Africa, *K. africana* roots are used as a purgative.



Lithops, or stone plants – which are ideally suited to pot culture – are found in the Western and Northern Cape, Free State, Gauteng, Northern and North West provinces, southern Namibia and just into Botswana near Gaborone. They have become famous largely due to the exhaustive publications by Professor Desmond Cole. Their decoratively marked leaves come in a variety of earthy colours. Only yellow and white flowers are produced and these open around midday. Orange flowers are a rarity! Some lithop bodies are a striking red/purple colour.

Mesems (vygies) (family Aizoaceae) see carpobrotus, faucarias, fenestrarias, gibbbaeums, glottiphyllums, pleiospilos and

Above: The common names for *Lithops* vary from area to area. In the Eastern Karoo they are known as Bokspoor (buck spoor) and in the Free State they are called beeskloutjies (cattle hooves)

Right: two members of the mesem family

titanopsis. The mesems make up a very large succulent family – varying in shape, size and colour – and originating in many different environments. A number of these plants grow in deserts, others in high-altitude alpine areas.

Pachypodiums are caudiciform* succulents found in South Africa, Namibia, southern Angola, southern Zimbabwe and Madagascar. Many of the species produce spectacular flowers.





Pachypodium namaquanum

Below right: *Pelargonium crithmifolium*

Succulent pelargoniums are found growing naturally in the Worcester/Robertson district, the Karoo and Namaqualand and Namibia. A number of ideal horticultural subjects fall into this category. They are summer deciduous and have fleshy, tuberous stems. In summer, when they are dormant, the stems are protected against the sun's rays by a dry parchment-like filament and a white bloom-like powder.





Left: *Pleiospilos* are known as liver plants – as they sometimes resemble a human liver

Below: *Stapelia grandiflora*

Opposite above: *Ruschias*, another important genus in the mesem family, are popular as groundcovers and rock garden subjects

Opposite centre: *Titanopsis calcarea*

Opposite below: *Tylecodon cactioides* flowers in December or January during the hottest time of the year. These plants are often responsible for diseases in sheep. 'Krimpsiekte' or shrivelling of the legs is a symptom

Some produce beautiful flowers in spring and early summer. The leaves in many cases are very aromatic. Succulent pelargoniums make ideal bonsai or caudiciform* subjects.

Pleiospilos are fat, chunky succulents occurring in the Northern Cape, Little Karoo, Eastern Cape and Great Karoo and are known locally as 'liver plants' because of their shape and colour. Flowers, ranging in colour from yellow to orange and pink, are borne in March, April or May. Species of *Pleiospilos* are easy to cultivate from seed and grow quickly.

Stapelias are characterised by their foul-smelling flowers (reminiscent of rotten meat), which are produced in March and April, with colours varying from black and mottled white to pinky red and yellow. *Stapelia gigantea* produces the largest flower of all southern African succulents – up to 14 cm in diameter. The strong carrion scent can be smelt at a great distance, especially during hot, balmy afternoons. Parts of *S. gigantea* are used by the Zulus as a remedy for hysteria.





Tylecodons are found in the Western Cape Northern Cape and Namibia. These handsome brutes with their architectural lines do well as container or focus plants in a small garden, paved courtyard or on a porch. They are responsible for many stock losses, due to 'krimpsiekte'. Many farmers therefore remove this plant, with the result that certain tylecodons have become endangered.

Titanopsis occurs in the south-western Free State, Northern Cape and southern Namibia. Low growing, either in clumps or singly, their leaves have a chalky appearance with whitish warts growing on the leaf tips. Powdery white-yellow flowers are borne during the winter.



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Below: Pollination of a stapelia flower by a fly. The rotten meat smell attracts flies

Right: *Aloe maculata*

Right below: *Tridentea pedunculata*, a member of the Asclepiad family



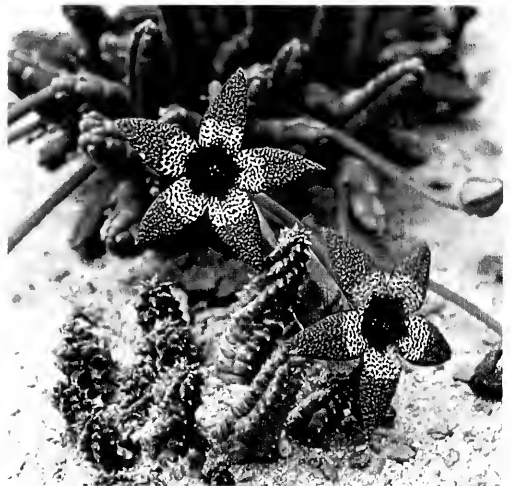
NATURAL POLLINATION OF SUCCULENTS

Most succulents have two or more growth forms (they are allotropic*) and the majority also make use of very striking, large and showy flowers. Exceptions include crassulas and other related species that have comparatively small flowers arranged in dense inflorescences*.

Examples of pollination methods include:

- ornithophily* (pollination by birds) which occurs in aloes and gasterias;
- myophily* (pollination by flies) which occurs in ceropegias, duvalias, huernias and stapelias, amongst others.

The dominant family of succulents, the mesems, in the southern Namib has



evolved groups with flowers that are pollinated by butterflies or moths, either by day or by night.

The phenomenon of mass flowering is a concentrated effort to offer pollinators a limited period of about three weeks in which to pollinate a population.

The successful pollination of 'midday flowers' is strictly controlled by temperature and light intensity.

These examples emphasise the point that it has become very necessary to study the natural pollinators of the various succulent species to enable us to imitate some of their techniques. It is interesting to note how the different physical characteristics, such as mouth parts, beaks and legs/appendages, all of which are used as pollinating tools, vary in shape, length and texture.

Access to knowledge of this kind does, to a certain extent, aid in the artificial pollination of the multitude of xerophytic* species.



Below: Mature fruit capsules of
Argyroderma



NATURAL DISSEMINATION AND DISPERSAL

Xerophytes* usually disperse seeds, but in some cases whole fruits are the dispersal units. In deserts, wind is a major dispersal agent – especially true of the Apocynaceae (oleander family), Asclepiadaceae and Asteraceae (daisy family).

Mesem dispersal systems can be complicated and complex. The fruits of this family have evolved a perfect adaptation to desert conditions. The mature fruits remain closed, opening only when conditions are favourable for germination. These fruits are known as hygrochastic capsules*. Rain drops disperse the seeds away from the mother plant over a certain distance. The seed release is part of a prolonged process which ensures that all the seeds are not released at exactly the same time under the same weather conditions.

Closely related to dispersal is the ability to reproduce asexually*. Cases in point are those of cephalophyllums, gasterias and stapelias.

Species with a prostrate habit and the ability to form adventitious roots disintegrate into separate individuals long after the central part of the mother plant has died.

Adromischus, cotyledons, crassulas, and even some haworthias regenerate into new plants from detached leaves.

Rosette-forming monocotyledons, such as aloes, can develop daughter plants on adventitious shoots at the base of their stems.

An interesting phenomenon in *Aloe claviflora* ('jakkalsstert' or 'kraalaalwyn', 'Jackal's tail' or 'Camp aloe') is that a single mother plant will form new plants

asexually*. The plants form dense, more-or-less circular clumps, and eventually the old inner plants die, leaving an outer ring. This habit has given rise to their common name 'kraalaalwyn'.



Above: The rugged habitat of *Aloe dichotoma*

Right: *Gasteria* seedlings

Opposite below: A stem cutting of *Cheiridopsis denticulata*





TIPS ON PROPAGATING SUCCULENTS

Asclepiads

These are very easy to cultivate, both asexually* and sexually.

Seed propagation

A very sandy medium can be used for the purpose of germinating the seedlings.

Asclepiads produce horned seed pods, which, when mature, burst open along their seams, releasing masses of flat oblong seeds each with a pappus* of a fluffy, cotton wool-like substance attached to one end. As the seeds are wind-borne, it is advisable to tape up the horn-like pods (use masking tape) when they are nearly mature, to prevent them from exploding and allowing the seeds to blow away.

✿ The fresher the seeds, the better the chances of germination.

Cover the seeds in their seed trays with a thin layer of soil, 5-7 mm deep. If planted too deeply, they will rot. Temperature is important and they should be kept in an area with a temperature of 25-35°C. Good air circulation and ventilation are crucial as bad air circulation could cause damping-off. The seedlings should be grown in 40% shade as bright sunlight, especially in summer, is likely to burn the plants.

It is always a good idea to treat the seedling medium with a pre-fungal agent. Previcure N, a soil drench, has proven to



Left: *Pachycymbium lugardii*

Below: *Quaqua acutiloba*

Opposite above: *Aloe plicatilis*

Opposite below: *Haworthia cymbiformis*

be reliable, although unfortunately, it is expensive. Alternatives like Dithane M45, Benelate, Captan and Funginex can also be used in the form of a drench directly after the seed has been sown.

Benelate has been known to stunt plant growth and retard seed germination. The systemic fungicide, Benelate is difficult to obtain in South Africa.

As far as watering is concerned, germinating seedlings require a slightly damp medium which means that it may be necessary to water every day during very hot weather. Always remember to water during the cool of the day, preferably in the early morning.

Once the seedlings have germinated and are about 5cm high, they may be pricked out and planted up (See the soil mix for asclepiads). Be careful not to damage the roots when pricking out.

Propagation from cuttings

The most important criterion is that the cuttings be given adequate time to dry out. Cuttings taken in summer should be given two weeks to dry out once severed from the parent plant. (Keep cuttings in shade.) The severed ends can be sealed with tree

sealer, flowers of sulphur or even crushed (powderised) charcoal. Hoodias and trichocaulons should be dried out for two months. Coarse, washed river sand is an ideal propagating medium. Another alternative is the seedling mix for asclepiads given on page 35.

The ideal rooting time is summer when temperatures are high. Cuttings taken in winter will probably not produce any roots until the temperature warms up. Place the cuttings in a vertical position in the soil medium.

It is always a good idea to use a pre-fungal drench just after inserting the cuttings in the medium. Ensure that the area in which the cuttings are placed for



the duration of their rooting is well ventilated and they receive about 40% shade. Water daily during very hot weather.

Aloes, gasterias and haworthias

The optimum conditions are similar to those for asclepiads.

Seed propagation

Do not sow the seeds too deeply in their seed trays. Sometimes a covering of coarse sand helps with the drainage around each seed. Water, light and ventilation requirements are the same as those for asclepiads.

If possible, try to use fresh seeds. If you plan to harvest your own seeds and store them for later use, dust them with an insecticide, eg Bexadust or Carbaryl, to stop weevils from eating them. Use pre-fungal agents as described under the section for asclepiads.

✿ Do not overcrowd seeds in the seed pan. Damping-off could result from seeds germinating too close to one another.

Propagating aloes from stem cuttings

Aloes can be grown from stem cuttings. *Aloe arborescens*, *A. arenicola*, *A. ciliaris*, *A. mitriformis*, *A. pearsonii* and *A. striatula* can simply be rooted in a very sandy medium. Most of the many branched aloe species that resemble shrublets can be treated in this way. Cut the stem cuttings from the parent plant and insert into a sandy medium.

Propagating aloes from truncheons

Truncheons are normally thick, branch-like cuttings that are pushed into a sandy soil. They can be used for species like *Aloe dichotoma*, *A. plicatilis* and *A. ramosissima*. Soil conditions should be very warm.



Propagating aloes by division

This method can be used for aloes that grow in clumps, for example, *Aloe brevifolia*, *A. variegata*, and many of the grass aloes can be successfully divided up into small plants.

✿ Let aloe cuttings and truncheons lie for two to three weeks before striking them. Seal the ends with a tree sealer or dust with flowers of sulphur. Strike cuttings during the warm period of the year. Cut back the old roots by two thirds.

Propagating gasterias from leaf cuttings

All species except *Gasteria rawlinsonii* grow well from leaf cuttings. The thick leaves can be neatly torn or cut away from the stem of the parent plant. After cutting away any dead or diseased tissue, the basal end of the stem can be inserted into a sandy rooting medium. (See soil mixture for asclepiad seedlings, on page 35.) The warm months are the best time to strike leaf cuttings. *G. rawlinsonii* grows well from stem cuttings – handle in the same way as aloe cuttings.

✿ Strike the cuttings during the warm season: October, November or March. Ensure the medium is well drained and is kept moist. Do not grow cuttings in the direct sun: 40 % shade should be adequate.

Propagating haworthias from leaf cuttings

As most haworthias are winter-growing, better cultivation has been achieved from September to October and in March and April. December to February is normally too hot.

Certain species respond well to cultivation from leaves. They include *Haworthia angustifolia*, *H. comptoniana*, *H. limifolia*, *H. mutica*, *H. pygmaea*, *H. springbokvlakensis* and *H. truncata*.

Neatly remove the leaf from the parent plant with a small piece of stem tissue attached, cutting away any dead or diseased tissue.

A sandy medium such as the seedling mixture given for asclepiads (page 35) is ideal for rooting *Haworthia* leaves. Half a part of coconut fibre (obtainable from most horticultural outlets) can be added to the mixture to allow for extra drainage and aeration.

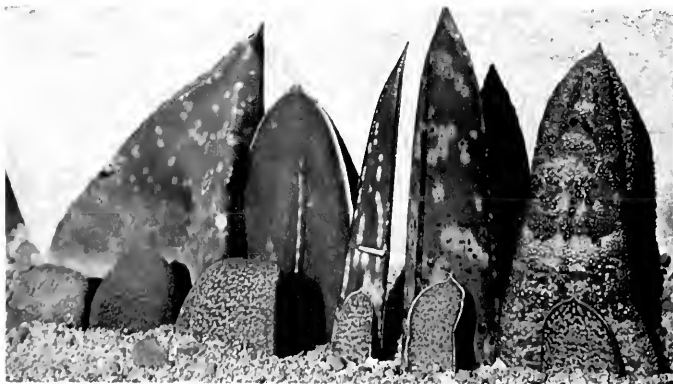
✿ The most suitable haworthias for leaf propagation are those with hard, fat, chunky leaves. Species with fat, soft leaves are not as successful, nor are those with hard or soft linear leaves.

Mesems (vygies)

The members of this large family, which is extremely diverse and is represented in a number of climatic zones, are easy to cultivate from seeds or cuttings.

Propagation from cuttings

Drosanthemums and *Lampranthus* can very easily be cultivated from cuttings. It is important to use a very sharp knife for these plants – secateurs will crush the stem and a blunt knife will tear away the thin bark. A pruning knife is suggested for this purpose. The cut should be made just



Gasteria leaf cuttings

Opposite: Mesems are the largest succulent plant family and are restricted to South Africa and western Namibia



below the node*. The cuttings can be struck in a sandy mixture or pure, coarse, washed river sand. The rooting medium must be very well drained, Strike cuttings during the warm season and ensure that the cuttings are kept well ventilated.

Carpobrotus, *cephalophyllums*, *chasmatophyllums*, *delospermas* and *mossias*, all of which have a prostrate form, strike well from their lower parts. Long trailing pieces can be cut and layered in a sandy mixture, resulting in many small plantlets.

Antimimas, *braunsias*, *eberlanzias*, *faucarias*, *hereroas*, *jacobsenias*, *octopomas* and *ruschias* are relatively easy to cultivate from heeled stem cuttings that include a piece of stem tissue. In some instances, tip cuttings have been successful. Strike cuttings during the warm

season. Use well drained coarse sand for this purpose. To guard against rot, it is important to drench the cutting medium as well as the actual cuttings with a pre-fungal agent

Seed propagation

Many of the mesems that flower profusely produce an abundance of seeds. Even if the pollinators are absent, the flowers can be hand-pollinated with a fine sable hair brush in the early morning when there is more pollen around.

Nearly 95 % of species have a loculicidal hygrochastic capsule*. In simple terms, this means that the capsule splits open releasing seeds when exposed to moisture and closes again as the capsule dries. An easy way of extracting the seeds is to break the dry capsule open with one's

finger-nails. Stubborn capsules can be given a light tap with a hammer, stone or compass point to prise them open.

To test if the seed is viable, drop a number of seeds into a glass of water. If the seeds swell and radicles (roots) push through within three days, they are viable.

✳ Damping-off is the greatest threat to seedlings.

Treat the seedling soil mix with a pre-fungal agent, like Previcure N. In Europe, Chinsol is used with great success. Do not overcrowd the seeds in the pan, and ensure that they have adequate ventilation. The optimum sowing time for many mesems is February or March. Provide 30% shade for germinating seedlings sown in summer. Note that seeds sown in autumn will have to be protected in areas that experience severe frost. The seedling mixture suggested for asclepiads (page 35) will suffice. The seeds should be sown on coarse river sand topping and should not be covered.

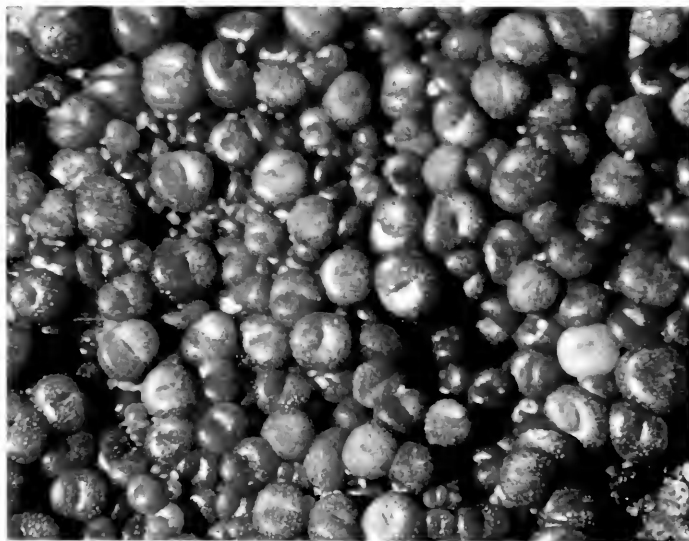
Argyrodermas, conophytums, *dinteranthus*, fenestrarias, lapidarias and

Lithops should be sown in midsummer (December and January) as they require a fair amount of heat to germinate. In the south-western Cape, *Didymaotus lapidiformis* grows well from seed sown in the early winter.

If you want a display of *Dorotheanthus* (Bokbaai vygies) in spring, sow in April/May in the south-western Cape and February on the Highveld and in the Free State. The colourful drosanthemums and *lampranthus* can be sown in March, pricked-out in August and planted in the garden by October. These plants can live up to eight years and will produce a mass of blooms in their second year.

Adromischus, cotyledons, crassulas, kalanchoes and tylecodons

The Crassulaceae (crassula family) is a very large group of plants which are distributed throughout South Africa. Many of these species grow on the cooler southern slopes under bushes or over rocks or larger plants. Others have adapted to harsh desert-like conditions.



A tray of healthy mesem seedlings

Opposite: *Cotyledon papillaris*

Propagation from cuttings

This group, with the exception of some of the *Tylecodon* species, are very easy to propagate from cuttings.

Adromischus and most crassulas grow from a single leaf. Kalanchoes and cotyledons also grow from a leaf, provided a small piece of the stem is attached.

Tip and stem cuttings, again with the exception of tylecodons, are very easy to cultivate. Most vegetative parts will root easily in a sandy mixture. The ideal time to root crassulas is during the warm months. Adequate air movement and 40% shade should be given. Keep the cuttings moist and they will form roots in a matter of days during warm weather.

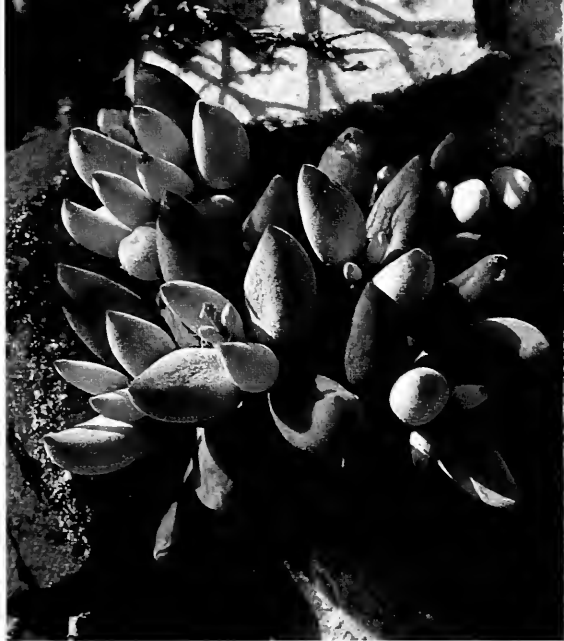
Seed propagation

The seed of most members of the *crassula* family are light brown and very fine, and the sowing methods are similar to those for mesems. Tylecodons are best propagated by seed. The seedlings grow quickly if they get enough light, moisture and ventilation.

Euphorbias

Euphorbia cuttings should be struck when it is warm, the ideal months being December, January and February. Most of the branched species, including the many miniatures, which make ideal container plants, can be propagated in this way.

All *Euphorbia* cuttings should have the severed ends sealed with tree sealer or dusted with sulphur, and the smaller ones should be left for a couple of weeks to dry out. Cuttings from the large tree-like species, such as *Euphorbia cooperi*, *E. ingens* and *E. triangularis* should be left to dry for a couple of months after they have been severed from the parent plant. The severed end should be dipped in a dry substance like dry sand, for a few minutes



to stop the flow of latex from the plant. *Euphorbia* branches may be cut off with a saw or a sharp knife. The severed wound can be trimmed with a sharp pruning knife, and all bruised, dead or damaged tissue must be cut out.

Root the cuttings either in sand or a sandy medium (see seedling mix for asclepiads, page 35) which must be kept fairly dry until the roots start to appear. Once this has happened, water the cuttings once a day during very hot weather. An old but effective practice is to fasten the cutting to a stake, which is then pushed into the soil until the base of the cutting just touches the soil. Very often, roots will form far sooner by this method than they would if the stem were pushed into the sand to a greater depth.

Seed Propagation

Euphorbia seed capsules are three-valved, each valve containing one seed. As the seeds are disseminated by explosive ejection, it is wise to cover the seed

capsules with a stocking or fine net. The period of germination, which should ideally take place during warm weather, may vary with age as well as with the species but it is always a good policy to use fresh seeds. The seedling mixture recommended for asclepiads (page 35) can be used. As always, ensure that the area is ventilated, use a pre-fungal agent and do not try to grow the seedlings in full sunlight. Damping-off may occur if the seedlings are overcrowded, or if they are over-watered, which may cause a rise in the humidity level. Keep the seedling mixture just slightly damp.

Adeniums and pachypodiums

These interesting caudiciform* plants make ideal container subjects. They are known to occur in the more arid regions of the country, with several species of tropical succulent pachypodiums endemic to Madagascar. Adeniums and pachypodiums are cultivated mainly from seed.

Seed propagation

These plants produce a pair of horn-like pods, similar to those of asclepiads. It is advisable to tape up the pods as they turn a pale brown colour. Use thin strips of masking tape if you have your own fruit. This will stop the fruits from splitting open and losing the seed. The seeds should be sown 5-7 mm deep in a sandy medium (the seedling mix for asclepiads on page 35, is excellent). Enough moisture and heat (27-35°C) will ensure the seeds germinate rapidly. Remember to use fresh seeds.

Propagation from stem cuttings

Certain species, including *Adenium multiflorum*, *A. oleifolium*, *A. swazicum*,

Pachypodium bispinosum, and *P. succulentum*, are easily cultivated from stem cuttings, particularly in late spring.

Gordon Rowley, in *The Adenium and Pachypodium Handbook*, 1993, suggests cuttings of 10-22 cm long. All cuttings should be sealed with tree sealer and can also be dipped in a mixture of Benelate and Previcure N to prevent rotting. It is advisable to dry the cuttings-out for about 8 days, after which some people advocate the use of hormone powder – Seradix 2 should suffice.

The best medium for striking these cuttings is the same as the asclepiad mix (page 35) but even coarse sand mixed with a little vermiculite will do. The medium should be kept fairly dry until signs of root development appear.

Propagation from root cuttings

Pachypodium bispinosum and *P. succulentum* can be used. Sections of the tap root, layered in a sandy medium, should produce results. Apply the method used for stem cuttings.

Propagation from cuttings

Stem succulents (examples)	Senecios	Conophytums
Adeniums	Stapelias	Cotyledons
Aloes	Succulent	Crassulas
Astroloba	Pelargoniums	Dinteranthus
Braunsias	Tavareasias	Fenestrarias
Cissus	Trichocaulons	Gasterias
Cyphostemmas	Tylecodons	Gibbeaums
Duvalias	Leaf succulents (examples)	Haworthias
Euphorbias	Adromischus	Kalanchoes
Fockeas	Aloinopsis	Lithops
Hoodias	Argyrodermas	Pleiospilos
Huernias	Astroloba	Portulacaria
Pachypodiums	Carpobrotus	Sansevierias
Piaranthus		Senecios



GRAFTING

Grafting can be defined as the uniting of the stem of one plant with the stem of another.

Adeniums and pachypodiums

Adeniums, especially *Adenium multiflorum*, can be grafted onto *Nerium oleander* root stock. These are marketed as container plants in Europe. One main advantage of this type of graft is that the plant may be watered quite freely without the danger of rotting.

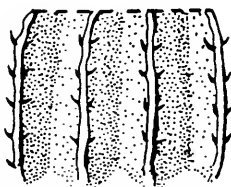
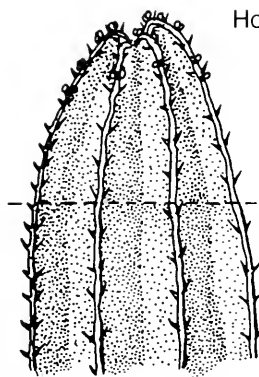
Pachypodium lamerei (endemic to Madagascar) is an excellent root stock plant for many of the more difficult-to-grow arborescent* pachypodiums.

p. namaquanum can be grafted onto *P. lamerei* in the seedling stage so the two plants develop together. The Europeans have been grafting this way for nearly 40 years with great success.

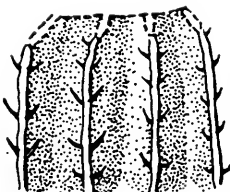
Euphorbias

There are various reasons for grafting euphorbias: Some species, for example *Euphorbia piscidermis*, which occurs in the Ogaden Desert in Somalia, do not grow readily on their own roots in cultivation. It therefore becomes necessary to graft them onto a compatible euphorbia with a stronger root stock. *Euphorbia handiensis*, indigenous to the Canary Islands, provides an ideal root stock.

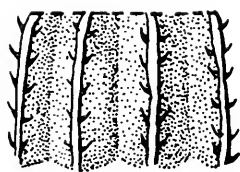
How to graft euphorbias



1 and 2 Cut the top off straight with a very sharp knife



3 Bevel the edges to stem the flow of latex



4 Remove the bevelled edge to create a flat surface again

In some cases, valuable plants may become weakened or be affected by rot. Grafting is the only way to save these plants.

It is generally accepted that flat and cleft grafting are the two most successful methods. One of the biggest problems in grafting euphorbias is the amount of latex (milky sap) that is produced when the plant is cut. After cutting the scion* to be grafted, one may stand it in water for a few minutes. This helps dissolve the sap to a certain extent, reducing the messiness of the grafting procedure.

Once the root stock has been cut straight, the scion must be placed on top of it and held firmly in position until the scion can support itself. It is important to remember that the root stock and scion should be roughly the same diameter; this will enable close contact of the meristematic* tissue, encouraging the scion and root stock to unite. During very dry weather, it is advisable to place the graft in a mist house to prevent it from drying out.

Other useful root stocks that can be used for grafting include those of *Euphorbia cereiformis* and *E. mammillaris* (from the eastern Karoo) and *E. ingens* (from the Northern Province).

Asclepiads

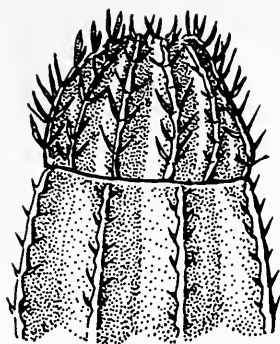
The cultivation of asclepiads using grafting presents a number of problems. There are certain genera and species that do not grow easily on their own roots in cultivation and this makes grafting essential.

Another common problem experienced by asclepiad enthusiasts is the fact that the root system is prone to infestation by woolly aphid. This eventually causes the collapse of the root system and black rot spreads upward into the stems. Even if a small piece of the plant remains untouched, but it is too small to make a cutting, grafting is the only way to save the plant.

According to the Dutch, grafting asclepiads was successfully done as early as 1938. It is a very simple process, far easier than grafting euphorbias. A very sharp, sterile knife or a razor blade makes an ideal instrument.

Either the flat or oblique methods of grafting can be adopted; in other words, one can cut the stem straight or at a slant. The oblique method has proved to be the most successful and is often used by horticulturists in Europe.

After the cut has been made, wait a moment or two to allow excess sap to flow away before joining the scion and root stock, which should be of roughly the same



5 Join the scion to the rootstock immediately

diameter. One can dust the severed ends with flowers of sulphur to prevent infections. A pin or cactus spine can be used to secure the graft in position.

Graft during the warm season when the sap levels are higher. Keep the graft out of bright sunlight for a few days and during very dry weather, place the grafted plant in a mist house.

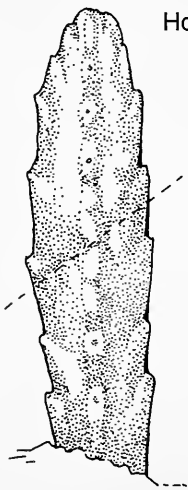
One must be careful not to graft any plants that have been sprayed with a

systemic insecticide, like Metasystox, as this will retard the union. Also ensure there is good air circulation around the plants to help prevent disease.

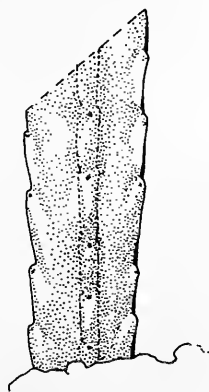
Most asclepiads provide compatible root stock for *Ceropegia occulata*, *C. linearis*, and *C. woodii*. *Orbea variegata* grafts well onto tavaresias and trichocaulons while duvalias and hoodias are suitable as root stock for *Stapelia gigantea*.

It is generally accepted that grafted plants grow faster and more luxuriantly than those of the same species on their own roots.

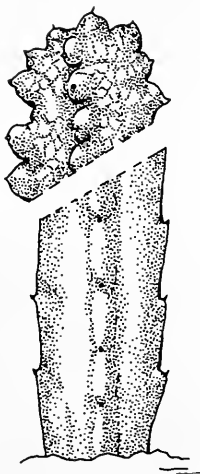
How to graft asclepiads



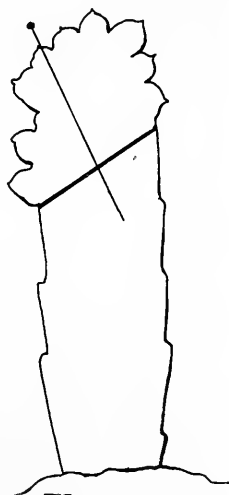
1 Cut the top off at an angle, using a clean, very sharp knife.



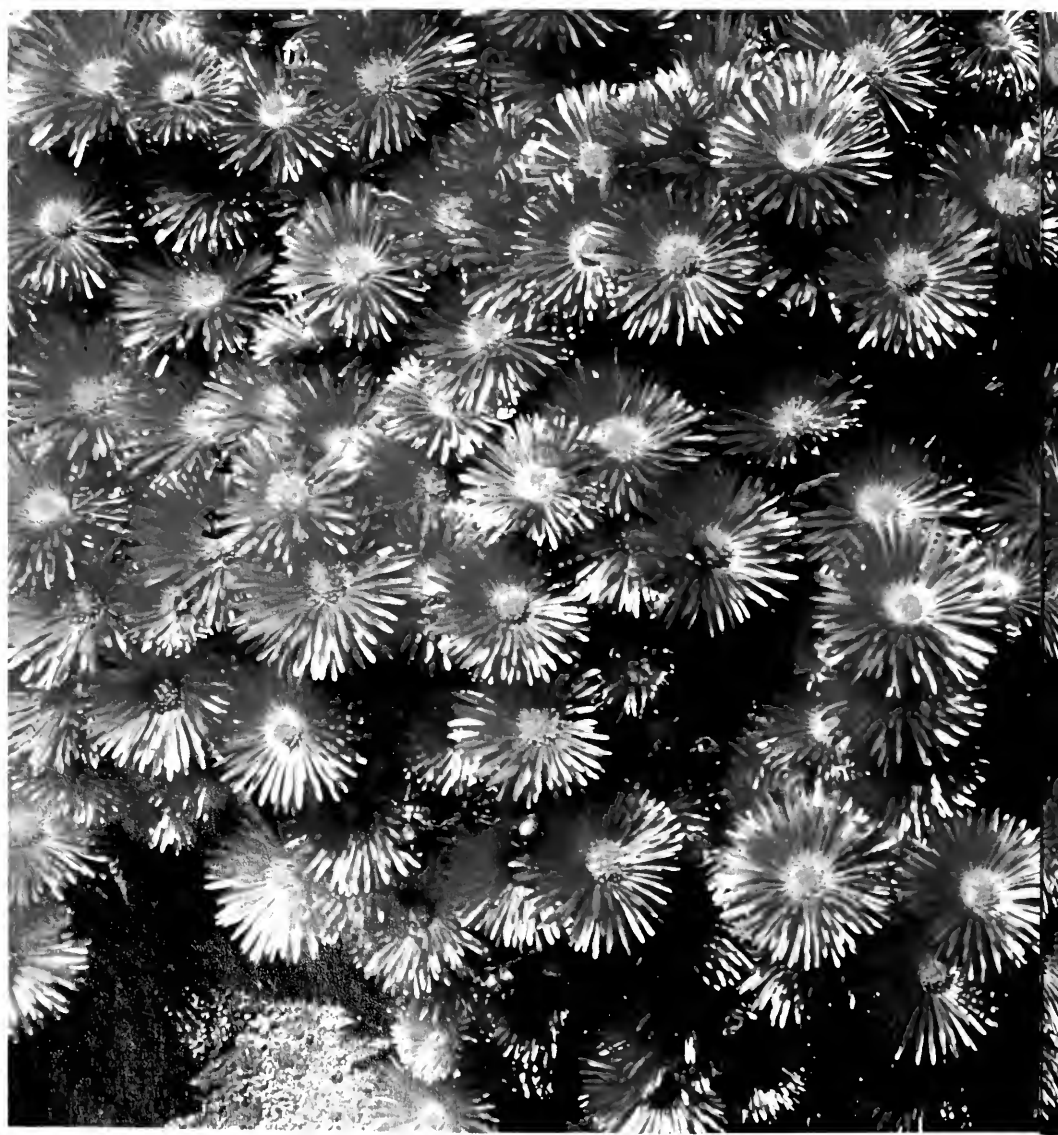
2 Ensure no grit falls onto the open wound. Avoid touching the wound.



3 Join the scion to rootstock immediately. Excess sap can be removed with a knife edge.

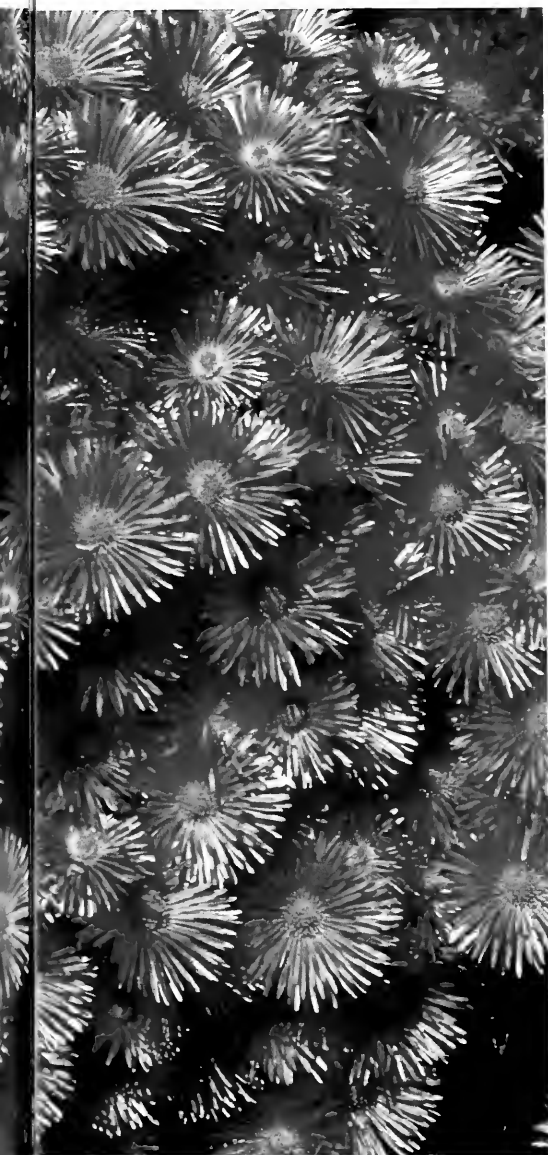
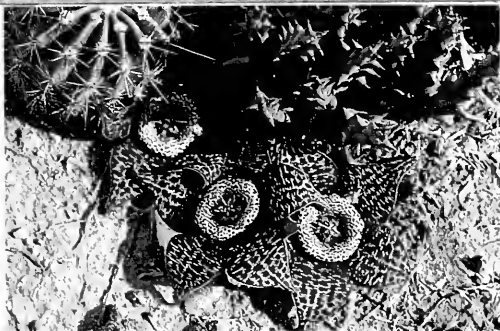


4 Use a pin or cactus spine to hold the graft in position.



Right: *Orbea variegata*
indigenous to the southern
Cape

There are 239 *Lampranthus*
species and varieties mainly
confined to the drier areas of
South Africa and southern
Namibia. Most *Lampranthus*
have very showy iridescent
flowers



SOIL MIXTURES

The soil in which succulents are planted is the most important aspect of the entire process of cultivation. Obviously soil from the natural environment of a plant is the ideal medium. As this is not always obtainable, succulent enthusiasts must try to emulate the natural growing conditions as closely as possible.

A few effective soil mixtures follow. With experience, one can experiment successfully with a wide variety of different soil combinations.

The most important criterion with succulents is good drainage. The pH should be around 6,5 to 7,5.

Asclepiads

This general mixture for asclepiad seedlings is recommended:

- 4 parts fine river sand
- 4 parts coarse river sand
- 1 part sieved, well-rotted compost
- 1 part perlite
- 1 part vermiculite

✿ Asclepiads are prone to numerous diseases and are perhaps among the most difficult of the succulent group to grow.

Notes on culture

If the soil turns green after a few weeks, this spells disaster for most asclepiads. The cause is often insufficient natural lighting in the greenhouse or perhaps too



much organic material such as compost in the soil.

Soil which cakes hard and develops a solid surface crust is not suitable for asclepiads. This normally happens if loam with a high clay content is added to the mixture. The use of perlite and vermiculite will break down the clay structures and allow water to penetrate to the roots.

If the soil forms a crust and curls outwards, it is also not suitable for asclepiads, as water runs off the impervious top layer, thus preventing moisture from reaching the roots. Clay content and acidity in the soil can cause the formation of a crust.

A badly drained soil can result in a build-up of toxic salts that may kill the plant. A whitish ring deposit on the rim of the container is a sure sign of salt build-up. Toxic salts can also accumulate when a

Crassula arborescens, possibly the largest of the crassulas – its specific name (*arborescens*) indicates its tree-like form and growth. There are 239 species of *Crassula* recorded in southern Africa

Opposite: *Euphorbia obesa*. When cut, euphorbias produce copious amounts of latex (white milk)

plant is left in the same soil and fed regularly over a period of years.

Plants will grow very luxuriantly if over-supplied with fertiliser and compost but under these conditions could be more susceptible to disease and insect infestation.

Mesems (vygies)

Some growers are convinced that many of these succulents should be planted in a virtually pure quartzite sand. This

necessitates regular feeding to ensure that the plants stay healthy and to promote growth. There is also a danger of fine hair roots drying out if the plants are not watered frequently enough.

The potting mixture is basically the same as that used for asclepiads, with one slight variation:

- 4 parts fine river sand
- 2 parts coarse river sand
- 4 parts sieved, well-rotted compost
- 1 part perlite
- 1 part vermiculite
- 1 part coconut fibre

✿ It is important to know where particular plants originate.

Conophytums can be planted in a clay-like base with a coarse sand topping. This will prevent the roots totally drying out during the hot, dry summer months in the Western Cape.

Certain *Lithops* can be given an additional one part of dolomitic lime as many occur naturally in alkaline soils. The same treatment can be applied to *Titanopsis*.

Dactyloopsis are reported by Hans Herre, first curator of the Stellenbosch University botanical garden, to thrive and live for many years if a pinch of salt is added to their water. These plants are found close to brackish pans in nature.

Haworthias

Haworthias are possibly among the easiest of all succulents to grow. The following soil mixture is recommended:

- 2 parts fine river sand
- 1 part coarse river sand
- 1 part sieved, well-rotted compost
- 1 part coconut fibre

Some horticulturists grow haworthias in pure well rotted coconut fibre or fern fibre or mix only a little sand with the fibre.

Adromischus, cotyledons and crassulas

The soil mix for asclepiads on page 35 is recommended. Even cuttings can be struck in this medium. One part of fern fibre can be added to give the mixture a little texture.

Gasterias

Gasterias make wonderful pot plants because they tend to grow very well in containers. A sandy medium with ample humus is all they need:

- 4 parts fine river sand
- 2 parts coarse river sand
- 4 parts sieved, well-rotted compost
- 1 part vermiculite
- 1 part perlite
- 1 part fern fibre

✿ Leaf cuttings of all gasterias, except *Gasteria rawlinsonii* (the trailing variety), will root in this medium.

Euphorbias

These are not always the easiest of succulents in pot culture. One must remember to dry out the very succulent



species for a few days. This is especially important if bruising or severing of the roots occurs. Euphorbias that are pouring latex (the white sap) need this drying-out period; without it they could rot.

The recommended mixture for euphorbias is the same as that for the mesems (page 37).

Once planted-up and kept adequately watered, they should grow vigorously.

Adeniums and pachypodiums

These make very interesting container plants, whether they are grown for the caudex or their striking flowers.

The same potting mixture for asclepiads (page 35) is recommended for adeniums and pachypodiums.

As with euphorbias, some members of this family should be given a brief drying-out period if they have been damaged during the repotting process.





PEST AND DISEASES

Environmentally friendly treatments

Many people are totally against the use of insecticides or pesticides. Unfortunately South Africa lags very far behind the rest of the world when it comes to controlling insects biologically. Below are a few simple but effective ways of controlling pests or diseases using environmentally friendly methods.



A biological control against red spider used in the municipal succulent collection in Zurich, Switzerland

Left: *Cotyledon orbiculata* – known locally as a 'plakkie' or pig's ear



Infestation of mealy bug on the growing tips of a *Tridantea* specie



Mealy bug in the crown of *Haworthia*

Pest or disease	Treatment
<p>Mealy bug – Fluffy, cotton wool-like sucking insects are found on the stem and the base of the stem just below soil level and deplete the plant of vital sap. They are spread by ants which feed on the honeydew deposits left by the mealy bug.</p>	<p>Wash off with a strong jet of water. Mix 50/50 methylated spirits and water, then remove remaining mealy bug colonies by dipping a cotton wool bud into the solution and wiping the insects away. Any remaining insects can be washed away with a further strong spray of water.</p>
<p>Aphid (green fly) These sucking insects come in green, black, brown and pale yellow. They usually feed on tender new growth.</p>	<p>Make a solution of 5ml liquid soap and 1l of water. Remove aphids with the force of the spray. Ladybirds will also control aphids. Ladybirds love feeding on aphids so, please do not use toxic sprays if there are ladybirds present. They do more good than harm!</p>
<p>Red spider mites are very small, about the size of a pin head, and give the plant a bronze sheen. They sometimes live in a web and, if left unchecked, distort and kill succulents. This pest is more common during hot, dry spells.</p>	<p>Soak 20 cigarette stubs in 1l water for one week. Add 2.5ml liquid soap to act as a spreader. Use to remove spider mites with the force of the spray.</p>
<p>White scale insects on aloes or euphorbias. They appear as a white coating on the exterior of aloe leaves or on the fleshy body of the euphorbias. These colonies of scale insects can be very destructive and in a few years will totally desiccate a mature plant.</p>	<p>A pressurized garden spray gun (connected to a tap) will do a good job in blasting them off the infected plant. Do not use a very highly pressurized spray gun that could bruise the plant. Another effective method of ridding plants of this pest, especially aloes, is to take a soft bristled broom and brush them off. The remaining white scale can be washed off with a pressurized spray gun.</p>
<p>Eelworms (nematodes) are microscopic worms that invade the plant through the roots, causing gross distortions and galls on the roots and thus restricting the passage of vital water and mineral salts needed for growth. Succulent pelargoniums and sarcocaulons are vulnerable to eelworm attacks.</p>	<p>Khaki bush or marigolds can be grown in close proximity to the plant that requires protection and then dug into the soil before they seed. The strong smell in the soil apparently drives the eelworm away.</p>

Pest or disease	Treatment
Damping off of seedlings. Wilt-producing fungi kill off young seedlings, which fall over at the point where the stem enters the soil.	Jeyes Fluid can be used to drench the soil before sowing. Mix 75ml in 10l of water for each square metre of potting soil. Sprinkle the solution on the soil and cover with a plastic sheet for 10 days before planting.
Slugs and snails are particularly troublesome in winter and spring in the south-western Cape. They munch away at the new and tender growth of vygies growing outside, especially bokbaai vygies, lithops and other vygie seedlings. The culprits come out at night.	Sprinkle a few grains of salt on the snails or slugs and watch them literally disappear in a sea of foam.
Doves and pigeons will eat seed sown in trays left in the open. All mesem seeds are their favourite delicacy. They are known to devour a tray of freshly sown seed in no time at all.	Cover seed with a pane of glass. Avoid hot, direct sun and remove once the seed has germinated. Move to a shadier, better-ventilated position.
Too much sun causes parts of the plant (particularly the upper stem) to turn reddish brown.	Move to a shadier, better-ventilated position.
House sparrows are particularly troublesome, pecking holes in dinteranthus and lithops.	Protect enclosure with bird wire.
Mice can also be troublesome gnawing their way into soft succulent-like plants.	Fine mesh, gauze, or bird wire may help.
Ants that spread aphids, scale and mealy bug. The ants are attracted to the honey dew deposits left by these insects.	Place a container of watered-down sugar near the infected plants. One heaped tablespoon sugar in 5l water.



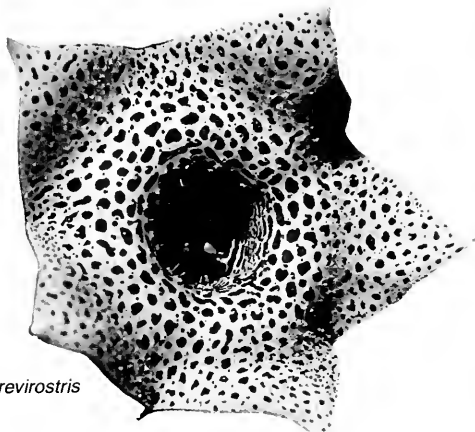
Sunburn on *Haworthia* exposed to summer sun



Haworthia with severe sunburn after sudden exposure to summer sun

Chemical treatments

A number of pests and diseases attack succulents and, more often than not, the damage is noticed too late. Vigilance teaches one to recognise the symptoms of the various pests and diseases in time for successful treatment. Useful information is contained in *The Layman's Guide to Garden Pests and Disease in South Africa*, by W.M. de Villiers and A.S. Schoeman (Struik, 1988).



Huernia brevirostris

Asclepiads

Asclepiads suffer from a variety of pests and diseases. The woolly apple aphid, *Erisoma lanigerum*, is one of the most damaging. Duvalias, hoodias, huernias and stapelias are among those asclepiads that are most vulnerable. The problem is that the woolly aphids, which mainly attack the roots, cause secondary infections, including black rot. The latter spreads through the entire plant, resulting eventually in collapse and death.

The pests and diseases common to asclepiads, and their treatment, follow:

Pest or disease	Treatment
Woolly aphid on roots and underground stem parts.	Confidor: 10ml/10l water Chlorpyrifos: 10ml/10l water Metasystox: 10ml/10l water Malathion: 25ml/10l water It is advisable to use a mineral oil as a spreader. (Mothballs in the soil helps).
Mealy bug on the stem and the base of the stem just below soil level.	Malathion: 25ml/10l water Chlorpyrifos: 100ml/10l water Confidor: 10ml/10l water
Red spider gives the plant a bronze sheen.	Oleum: 200ml/10l water Diazinon: 16ml/10l water. Malathion: 25ml/10l water
Black rot (fungus) is mainly a secondary infection that follows woolly aphid attack.	Remove all traces of black rot using a sterile knife. Spray the plant with Benelate and dust with flowers of sulphur.

Asclepiads *continued*

Pest or disease

Aphids (green fly) usually go for soft, tender new growth.

Treatment

Use an aphicide.

Stapelia borer penetrates the succulent stem and causes damping off, mainly during the seedling stage.

Rogor: 10ml/10l water

Previcure N: used as a pre-damping off agent. To be used as a drench immediately after seeds are sown

Benelate: 5g/10l water

Thiarum: 10g/10l water

Scale Sticky to the touch, they are circular in shape, and range in colour from black and brown to white.

Oleum: 100ml/10l water



Black rot spots on Asclepiad roots. This is the secondary infection as a result of root mealy bug infestation

Right: *Viscum minimum* growing on *Euphorbia polygona*. This curiosity is found in the eastern Karoo





Opposite right: Damage done to *Lithops* by the larvae of a moth. Note the culprits pupating on the side of the pot

Left: Damage done to *Glottiphyllum* leaves

Opposite far right: Bacterial infections on a *Euphorbia*, possibly caused by orange stink bugs

Mesems

The most susceptible include cheiridopsis, conophytums, dorotheanthus 'Bokbaai vygies', fenestrarias, lithops and pleiospilos.

Pest or disease	Treatment
Woolly aphids	See section on asclepiads
Mealy bug, found in lithops in the cleft between the two leaves.	See section on asclepiads
Mice chew chunks from lithops leaves.	Use conventional methods such as traps and stomach poisons. (Ensure poisoned mice aren't eaten by the family cat!)
Caterpillars (Moth larvae) are a major threat to conophytums and are extremely difficult to see until the damage has been done.	Metasystox: 5ml/5l water repeated three times at fortnightly intervals.
Worms (moth larvae) eating lithops and conophytum.	Baythroid wettable powder (wp) registered for American bollworm works well. Baythroid 10g/10l water.
Soft brown and white scale, particularly on carpopobrotus and cephalophyllums.	Oleum: 100ml/10l water
Rust causes reddish-brown blotches on the surface of plants – dinteranthus, lithops and pleiospilos are particularly prone to this.	Copper oxychloride: 50g/10l water. Mancozeb: 20g/10l water.
Aphids normally attack new growth on succulents.	See section on asclepiads
White fly are small sucking insects that attack the underside of tender new leaves	Baythroid: aerosol spray – administer a light application. Ripcord-18: 1ml/10l water
Fungal rot – a brown, watery blemish on the plant.	Remove damaged areas with a very sharp, clean knife. Treat plant with flowers of sulphur and then spray with a mixture of Benelate and Dithane M45.
Rotting of mesem bushes (fatal).	Ridomil ML. 30g/10l water



Euphorbias

Many euphorbias are prone to a number of pests and diseases

Pest or disease	Treatment
Brown Scab is a light to dark brown marking growing from soil level upwards. Lesions appear at a later stage, eventually killing the plant.	Blitox; a copper oxychloride base can be used. Dose: 30g/10l water
Soft brown scale	Oleum: 100ml/10l water mixed with Malathion at the rate of 25ml/10l water
Red spider	See section on asclepiads, p42
Crown rot is internal rotting that causes the top of a plant to collapse.	The affected part should be removed immediately using a sharp sterilised knife. Seal the wound with crushed charcoal and dust with flowers of sulphur or seal the wound with tree sealer, ensure the wounded area to be sealed has dried out completely.
Stem rot causes the stem to rot away, normally at ground level.	Remove rot. Make the healthy part into cuttings and strike in sharp sand. Dry off the severed end of the plant and treat with flowers of sulphur and tree sealer.
Blotchy stem rot in large plants is caused by orange stink bugs.	This is probably a type of bacterial rot passed on by the sucking mouth-parts of the bug, and once the rot has set in, it is very difficult to eradicate. Use Metasystox 10ml/10l water to control the bugs. Cut away diseased sections and treat the plant with copper oxychloride spray.
White scab – a pale whitish circular marking on the body of the plant.	Spray Ridomil ML 30g/10l water every 2 weeks until improvement is noticed.

Aloes, gasterias and haworthias

Pest or disease	Treatment
Aphids (green fly) are commonly found in the crowns, sucking the new growth, and it is possible that they pass on viruses. Aphids can also cause the total collapse of small aloes. This is especially the case where the leaves are soft and succulent.	See section on asclepiads, p42 The following treatments are also recommended: Malathion: 25ml/10l water. Garden spray (aerosol). Follow instructions on can. Metasystox: 10ml/10l water.
Ants give protection to scale insects, mealy bug and aphids by collecting the honeydew produced by these insects.	Spray with Chlorpyrifos, Baythroid or Metasystox.
Snout weevil (active mainly in summer months) does little damage, only leaving scars on the borders of aloe leaves. The larvae, however, burrow into the crown of the plant and could destroy the entire plant.	Metasystox: 10ml/10l water Malathion: 25ml/10l water. Bexadust or Carbondust. Once the larvae are dead, cut away the damaged section, treat with flowers of sulphur and supply tree sealer to large open wounds.
Witches' broom or aloe cancer is a viral infection probably caused by mites. Growth-like protrusions appear at crown level or just below the base of the crown.	Remove growths with a sharp knife and destroy. Sterilise all knives and pruners for future use. Use the following as a cover spray: 15ml Dyant; 5ml Chlorpirifos mixed with 10l water. Spray once a month for six months. Metasystox 10ml/10l water applied every three weeks over a six month period can help.
White scale on aloes and euphorbias causes a whitish appearance on outer leaves, usually starting at the basal section (on aloes) and spreading upwards. Not only does it look unsightly but it can spread viral infections that could kill the plant. Rust occurs mainly on aloes in the form of reddish-brown patches. If left unchecked, it will cause the disintegration of the plant.	Oleum: 100ml/10l water. Use as a full cover spray. Repeat at fortnightly intervals, until the scale is dead. The dead scales can be removed with a soft brush or broom.
Rust is also sometimes found on gasterias.	Cut away the diseased parts. Spray the plant with copper-oxychloride (Blitox, Virikop): 50g/10l water
Unidentified hairy black caterpillars (larvae of moths) can cause considerable damage to the crown and basal leaves of haworthias.	Drench soil and plants with Metasystox R: 10ml/10l water.
Woolly aphids are found in the crown of haworthias, in the basal stem below ground level and sometimes on the roots.	See section on asclepiads, p42

Aloes, gasterias and haworthias *continued*

Pest or disease

Treatment

Mealy bug is found in the crown of haworthias.

See section on asclepiads, p42.

Leaf bug occurs mainly on aloe leaves which it colours pale green. The bugs can be seen moving across the leaves, especially when disturbed.

Dust crowns and leaves with Bexadust. Spray Chlorpyrifos as a full cover spray: 10m/10l water.



Damage done to aloes by Snout beetles (Weevils)



White scale infestations on aloe leaf

Safety hints for the spraying of insecticides and fungicides

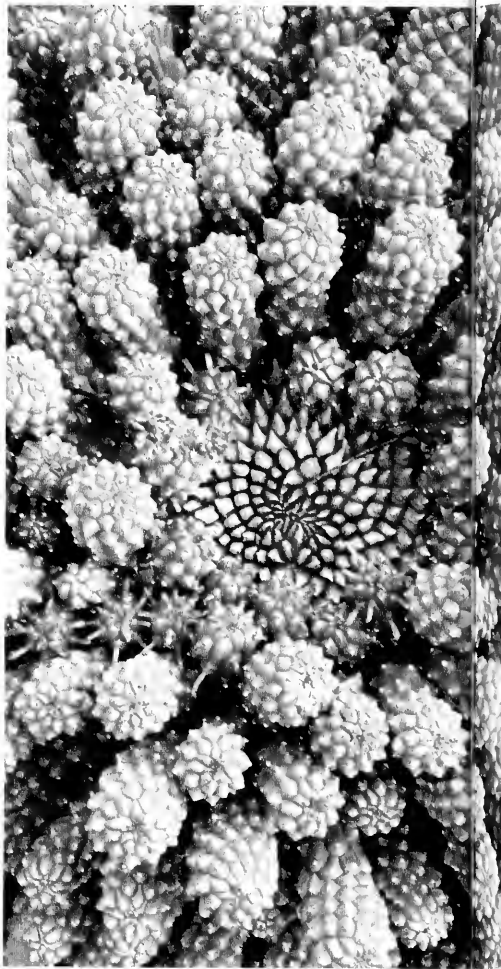
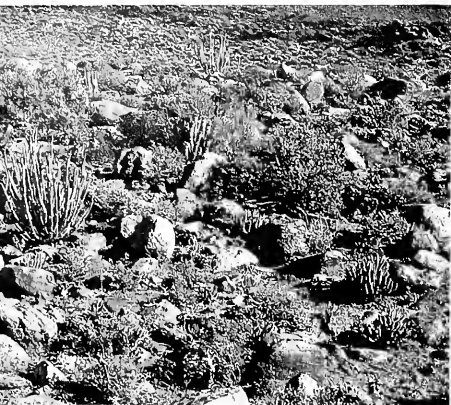
Never forget that pesticides and fungicides are poisonous and therefore potentially dangerous. A few simple, common-sense safety rules follow:

- 1 Always read the instructions on the bottle or tin carefully.
- 2 Wear rubber gloves when pouring or weighing a concentrate before dilution. Do this in such a manner that any fumes or dust will drift away from you.
- 3 Never spray during the heat of the day or when there is a strong wind blowing. Early mornings or late afternoons are ideal spraying times. Always stay well away from the spray drift.
- 4 When using toxic pesticides like Metasystox or Malathion, always use a full face mask. In fact, it is sound practice to wear a face mask and gloves whenever spraying, no matter what the substance.
- 5 Wash your hands well with soap and water immediately any spillage occurs.
- 6 Never smoke, drink or eat during application. If you decide to take a break, always wash at least the hands and face before doing any of these things.
- 7 Wear an overall or old clothing that covers most of the body. Shower and change out of your spraying clothes as soon as the job is complete.
- 8 Store all toxic chemicals away from foodstuffs and out of the reach of children and animals.
- 9 Label cabinet where poisons are stored appropriately and in line with the current safety regulations.
- 10 Ensure poison store is well ventilated.

Left: Note the high incidence of succulent plants in the Richterveld

Below: The multi-stemmed – *Euphorbia caput-medusae*, found on the Cape Peninsula

Right: Overwatered *Lithops meyeri* showing signs of splitting





WATERING SUCCULENTS

Rainfall in South Africa is divided into three categories:
all year rainfall area;
winter rainfall area;
summer rainfall area;
with 60% or more of all succulent plants occurring within the latter two areas.

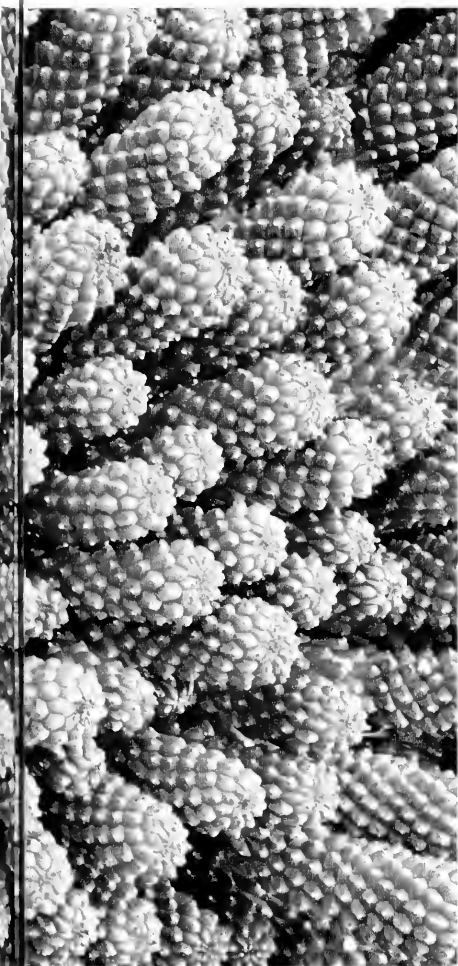
The winter rainfall area encompasses the south-western Cape, Namaqualand, the Richtersveld and the coast to just south of Oranjemund. The annual rainfall varies from about 80mm in parts of the Richtersveld to over 1500mm in the Cape mountains. It is generally accepted that the north-eastern cut-off point for this area is Laingsburg.

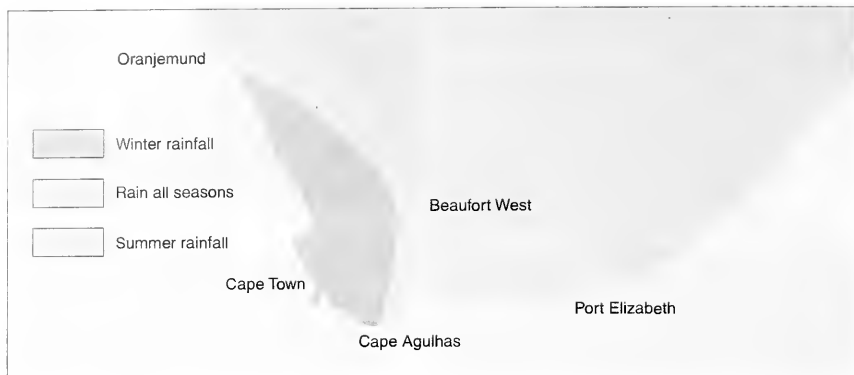
The summer rainfall areas include the North-West Province, Gauteng, Mpumalanga, the Northern Province, Lesotho, the Great Karoo, Northern Cape and Swaziland.

All year or uniform annual rainfall occurs along the coast from Mossel Bay to the Fish River in the Eastern Cape, in a narrow band to the east of the winter rainfall areas.

A watering programme

Step 1 Establish the origin of the plant. It may be a *Crassula* from a high rainfall area in the Drakensberg, or a *cotyledon* from a desert area in the Richtersveld.





Step 2 Establish the season during which the plant should receive most of its water supply. Does it originate in a winter rainfall area?

Step 3 If possible, try to establish in what type of soil the plant was growing. Some crassulas grow in relatively heavy clay-like soils. If this type of *Crassula* were planted in a very sandy soil, it would soon dry out and probably die.

Many succulents (especially coffee table plants) are overwatered by concerned owners. As a general rule, the successful grower will not run the risk of overwatering plants, provided there is good drainage in the soil.

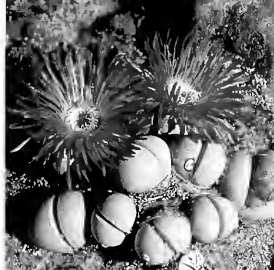
It is not always easy for the ardent succulent enthusiast to divide his collection according to summer and winter rainfall areas. At the Karoo National Botanical Garden, for example, we have the winter and summer rainfall crassulas, huernias, lithops and stapelias all growing together, but we have marked all summer rainfall plants with a blue label peg. Thus, someone who may not be familiar with these plants will soon have an idea which plants to water more than others in summer.

Generally, the winter rainfall succulents are given a good drenching once every two weeks during the winter. The summer rainfall succulents are watered once a week, especially during the hot dry Western Cape summers. In the dry summer rainfall areas it may be necessary to water only once a week or every 10 days, depending on how high the humidity is. In areas where the succulents do not have much protection from frost, it is advisable to start reducing the watering from early April. If the plants become turgid during extreme winters, the cells are likely to burst. Plants like *dinteranthus*, *lithops*, and even *pleiospilos* are prone to severe cell damage if their water content has not been reduced.

An interesting observation was made about the succulent collection in the city of Zurich. There they believe in watering well during the growing season, namely summer. Succulents from a variety of climatic zones are drenched twice a week, but it is important to note that all the succulents are housed in well-ventilated glasshouses.

Experience has proved that plants that are overwatered and fed too often are

Right: There are 11 *Argyrodema* species most of them originating from the Knersvlakte in the Western Cape



usually susceptible to disease. At the Karoo National Botanical Garden, we prefer to grow the plants slightly on the hard side.

Owing to the many different microclimates and climatic zones in South Africa, it is not always easy to determine an accurate watering policy. Generally, if the humidity is high for weeks on end, it will probably not be necessary to water a succulent collection from Namaqualand, the Karoo or the Richtersveld for the duration of the humid spell. During extremely hot dry conditions, the plants need more water.

✿ If it is at all possible, try to use rain water. The many salts, particularly chlorides, found in city water tend to retard the growth of certain succulent plants.

If rain water is unobtainable, try to use water with a pH of around 7.

Succulents that are starved of water normally show signs of drought stress; Haworthias and aloes fold their crowns inwards, thus protecting the crown centre from the blazing sun. Conophytums, cotyledons, crassulas and lithops take on a shrivelled appearance, while some asclepiads become floppy and shrivelled.

It appears that some succulents simply do not like water droplets on their leaves.

Certain mesems, namely *Didymaotus lapidiformis*, *Dinteranthus*, *Pleiospilos nelii*, and some haworthias and stapelias, when watered from above (especially with municipal water), are left with markings once the water droplets have evaporated.

VENTILATION AND LIGHT

Ventilation

Overcrowding and poor ventilation can lead to fungal and bacterial problems.

Adequate ventilation and good air circulation should be maintained by air vents and extractor fans (in glasshouse structures). One should try not to pack the plants too closely, leaving a space between containers to allow for air circulation. Lift the containers above the bench by using Expandite metal mesh frames 3-6cm high.

Light

Too much or too little light can be detrimental to succulents. Once again it is important to know how the plants grow in nature. Some succulents grow in the protective shade of nurse plants; for example, many of the crassulas, duvalias, haworthias, huernias, and stapelias would not survive full summer sun but for the fact that, as the sun moves in its arc overhead, the plants are shaded throughout the day by patterns of shade cast by the nurse plants. Likewise, *Dinteranthus*, *Lithops* and *Pleiospilos* among others, prefer more sun in order to flower to perfection and are therefore referred to as midday flowering plants.

Many overseas botanical gardens that cultivate southern African succulents tend

to allow too much sunlight, resulting in sunburnt plants. The asclepiads, when overexposed to sun, produce pink-brown stems, the chlorophyll seeming to have totally disappeared in some cases.

Generally speaking, most succulents should receive about 40% shading, with midday flowering plants doing well with

20% shading. During the winter months, any netting used to provide shade in summer should be removed to allow for maximum lighting. At the Karoo National Botanical Garden we use shade net on wire runners, suspended about 1,5m above the plants. This allows for accurate manual control and monitoring of lighting.



Most succulent plants make ideal container subjects



CONTAINERS

Types of containers

Containers are a very important part of succulent growing. While 'clothes maketh the man', in many cases it is true that 'the container maketh the plant'.

Today, containers come in a variety of shapes, colours and materials. Normally a container is as deep as it is broad. The small, three-quarter or half containers are sometimes called pans. At the other extreme, particularly deep containers are called Long Toms.

An important consideration when choosing a container for succulents is its capacity for drainage. It is not always necessary to crock (use rubble at the base of the container) if there are adequate drainage holes and if an easy-draining potting medium is used.

A broad container has greater stability, so where a choice is available, look for a container with a broad base and almost vertical sides. This shape also allows for a greater volume of soil within the container.

Personal preference is the main criterion in the choice of a container and a variety of interesting options is available. Terracotta containers in earthy colours are popular – planted with linear or chunky succulents they make an attractive display grouped together in a rustic courtyard. At the other end of the scale, some people even choose psychedelic contrasting colours.

The more unusual containers can be used for displaying specimen plants, while smaller plants like conophytums, haworthias and lithops look good in ceramic containers.

Colour too is a subjective issue but remember that white reflects light and warmth and that darker colours absorb light and heat.

Natural decorative accessories

Carefully chosen accessories may enhance an arrangement of succulents and much can be achieved by using natural stone and driftwood in one's containers. Plants, especially lithops, can be cryptically hidden amongst similar looking stones or they can be made to stand out obtrusively. Sculptured driftwood can also be used with great effect to harmonise with the plants in the container.

Square or round container?

Square containers generally make better use of space than round ones. They can be fitted together exactly to cover an area without any wastage. They also generally

contain a greater volume of soil relative to their surface area.

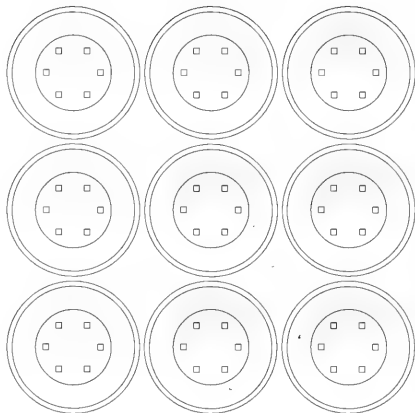
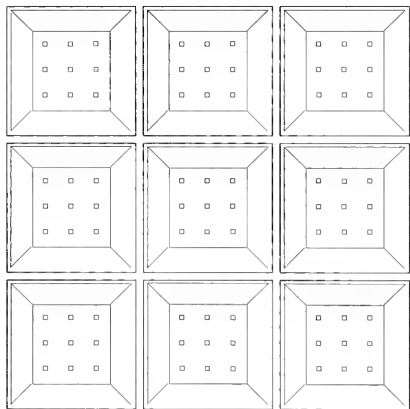
On the negative side, square containers are more difficult to fill, as one must ensure that the medium is pushed well into the corners.

Clay or plastic containers?

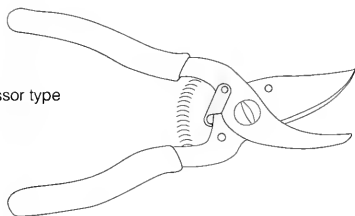
Many succulent growers will argue that clay is better than plastic. After all, clay containers are porous and help to compensate for over watering. Clay containers also look far more aesthetically pleasing than plastic pots.

Traditionally, containers were made of clay, but consideration of cost, durability and weight have resulted in a reduction in production.

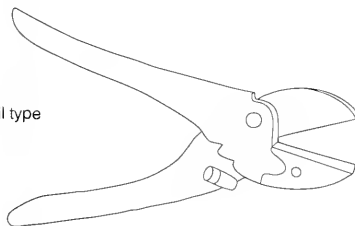
Plastic containers are cheap, light, easy to wash and are produced in a variety of shapes and colours. One drawback is the fact that cheaper plastic containers are photo-degradable and soon become brittle when exposed to ultraviolet light.



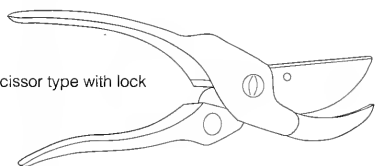
Scissor type



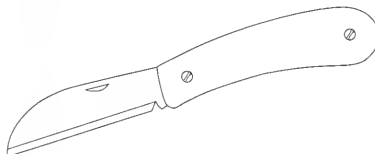
Anvil type



Scissor type with lock



Grafting knife



Pruning knife



CHOOSING THE RIGHT TOOLS FOR THE JOB

The right tools often make the difference between success and failure and they certainly enhance the pleasure of succulent horticulture.

- 1 Adjustable nozzles – these come in several forms, varying from trigger action to ring action. The force and spread of water can be fairly accurately controlled.
- 2 Ten-litre watering can – a metal watering can will outlast any plastic watering can. The disadvantage is its relative weight. A plastic can is light and easy to handle and should last well enough if it is not exposed to direct sunlight for long periods of time.
- 3 Watering rose – this must be made of brass. It is ideal for watering young plants and seedlings with insecticides or fungicides. The brass rose, if cared for correctly, will last many decades.
- 4 Secateurs – scissor action. Always go for good quality – the Swiss-made Felco is one of the best available. Particles of dirt tend to clog scissor-action secateurs with a lock, while anvil-type secateurs tend to crush and bruise plants.
- 5 Grafting knife – has a straight, slightly wider blade. Go for quality: German and Swiss-made knives are usually excellent.

- 6 Pruning knife – this has a curved blade and a heavy handle that can be securely gripped.
- 7 Fogger (mister) the ideal item for misting fine seed like that of mesems and crassulas.
- 8 Metal sieves – indispensable for sieving soils, compost and sand. An ordinary flour sieve is ideal for this purpose.

Euphorbia polygona. This plant, with strong architectural lines, comes from the eastern Karoo

Opposite: *Dorotheanthus bellidiformis*





SUCCESS WITH SUCCULENTS

The cultivation of most succulents is not as difficult as many of the experts would lead one to believe. Obviously, there are still many hidden secrets, but start with the following general principles and success will not be unattainable.

- 1 Make sure the growing area is kept spotlessly clean.
- 2 Remove or treat any diseased plants without delay.
- 3 Ensure that air circulation is adequate.
- 4 Use pre-fungal agents as a soil drench to halt fungal infections.
- 5 Before introducing new plants to your collection, treat them with broad spectrum insecticides and fungicides.
- 6 Before re-using pots or containers, wash them in Jeyes Fluid.
- 7 Ensure there is adequate light in the growing area. Remember 40 % shade is best for all succulents except mesems. For most mesems, 20-30 % shade is ideal.
- 8 Ensure the growing mediums are light and that they drain well.
- 9 In cold areas, reduce watering gradually from March and give very little water during winter (applicable to the Highveld).
- 10 Drench your plants on a weekly basis during the growing season, which will differ in different climatic zones.



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GLOSSARY OF TERMS

adventitious: pertaining to nodules on stems and roots

albino: white in colour.

allotropic: occurring in two or more forms

apical: topmost, pertaining to growing point of plant

arborescent: treelike

asexual: pertaining to propagation by cuttings or division

carriion smell: similar to rotten meat.

caudex: swollen stem base of plant

caudiciform: pertaining to trunk like swollen stem base

chloroplasts: cellular organelles containing green-coloured protoplasm

dioecious: plants with separate male and female sexes

hygrochastic capsules: seed pods which open once wet

inflorescence: arrangement of flowers on a floral axis

monoecious: separate reproductive organs present on same plant

myophily: pollination by flies

node: point at which leaves and flowers are borne

ornithophily: pollination by birds

pappus: parachute tufts of hairs

scion: upper portion of grafted plant

sexual: pertaining to natural propagation by seed

window plants: plants that allow sunlight to travel through a transparent section of the plant to activate the underlying green chlorophyll cells

xerophytes: plants adapted to arid conditions

xerophytic: adapted to grow in dry conditions



ADDRESSES

National Botanical Gardens that cultivate
and sell succulent plants.

Karoo NBG, Roux Way, Panorama, Off
National Road (N1) P O Box 152,
Worcester 6850, SA: Tel (0231) 70785
Fax (0231) 28719
Email: karroid@intekom.co.za

Kirstenbosch NBG, Rhodes Drive,
Newlands, Cape Town. Private Bag X7,
Claremont 7735, SA: Tel (021) 762 1166
Fax (021) 797 6570
Email: info@nbict.nbi.ac.za

Botanical Society Garden Centre at
Kirstenbosch, Rhodes Drive, Newlands,
Cape Town. Tel (021) 762 1621
Fax (021) 762 0923
Email: botbkshp@iafrica.com

Pretoria NBG, 2 Cussonia Avenue
Brummeria Pretoria, Private Bag X101
Pretoria 0001 Tel (012) 804 3200
Fax (012) 804 6200
Email: nbi@nbipre.nbi.ac.za



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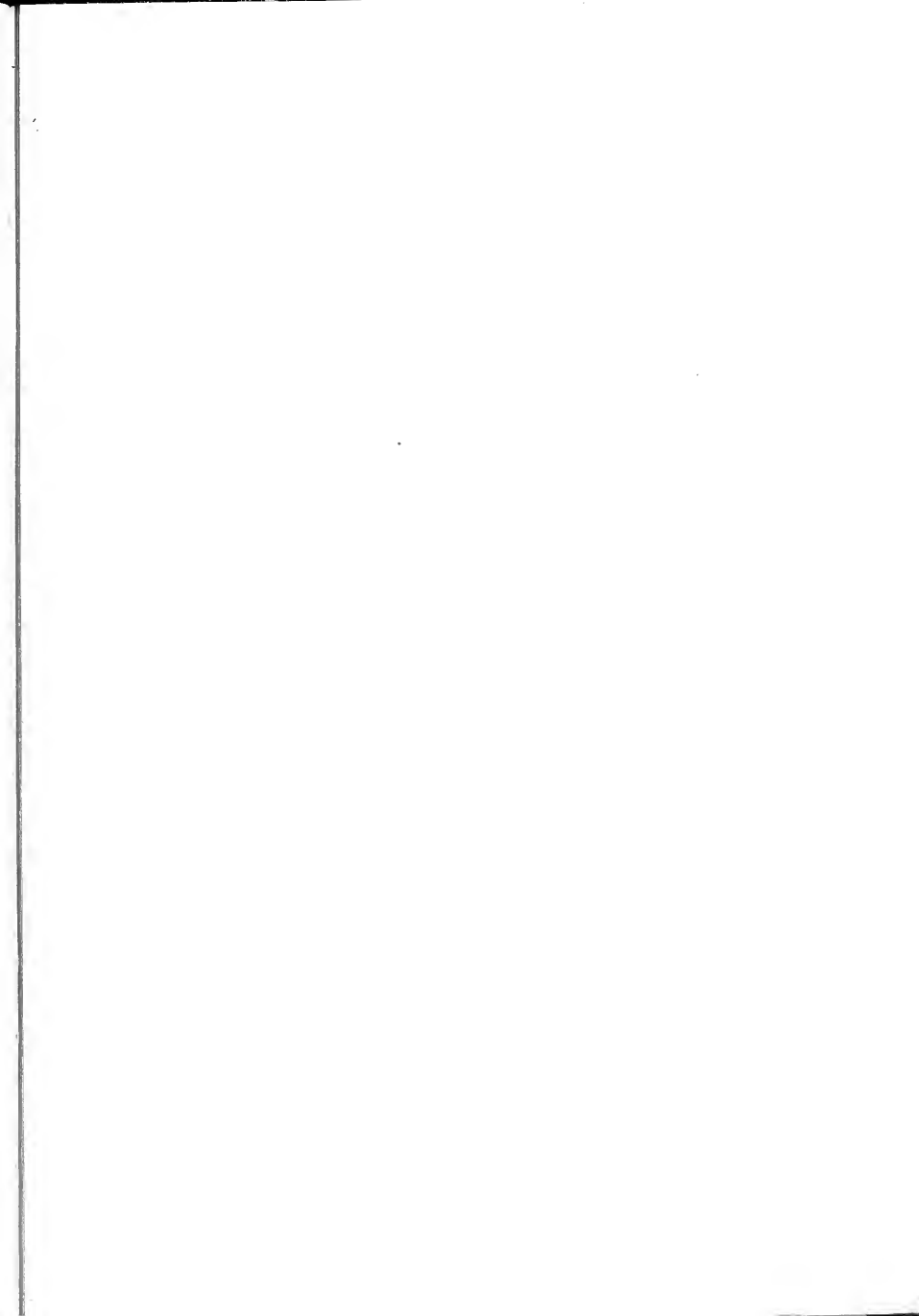




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